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PALEONTOLOGY.—*On the fossil Mammalia of the first interglacial stage of the Pleistocene of the United States.*[1] OLIVER P. HAY.

The writer accepts the conclusion of most recent geologists that there have been in North America four, possibly five, distinct glacial, and three, possibly four, interglacial stages. He holds, with most geologists, that during each glacial stage there prevailed at and beyond the border of the ice an arctic climate, which compelled the animals and plants either to retreat or to perish. Evidently at the beginning of the Pleistocene there existed an abundant fauna and at its end a meager one. If we seek the prime cause of the disastrous effects on the living things it will be found in the successive glacial climates.

I can not accept the view of the Iowa geologists that the fossil animals found in the western part of the State, except perhaps a musk ox, existed there during the height of a glacial stage; nor is there sufficient evidence for us to believe that elephants existed there before the Nebraskan stage.

Unfortunately the fossil remains found in the Aftonian deposits in Iowa are too often fragmentary; but according to our present knowledge, the following mammals inhabited that region at that time.

Megalonyx jeffersonii
Mylodon harlani
Equus complicatus
E. niobrarensis
E. scotti
E. laurentius
E. excelsus
Mylohyus? temerarius
Elephas imperator
E. columbi
E. boreus
Camelops? sp. indet.
Alces shimeki
Aftonius calvini
?Symbos cavifrons
Bison sp. indet.
Stegomastodon mirificus
Mammut progenium
M. americanum
Castor canadensis
Castoroides ohioensis
Euarctos americanus

[1] Received Oct. 22, 1930.

These fossils form the corner stone of our knowledge of the succession of North American Pleistocene vertebrates.[2]

West of Missouri River the Equus beds of Cope, the Sheridan beds of Scott, extend from the glaciated region of South Dakota to the Gulf. They appear to be a continuation of the Aftonian of Iowa and to contain some of the same species and many in addition. On the Plains these beds are widely overlain by deposits of loess, sometimes very deeply.

In Nebraska, about Seneca, have been collected *Equus niobrarensis*, *E. excelsus*, *Camelops?*, *Platygonus*, and probably *Elephas imperator* and *Stegomastodon mirificus*.[3] Some of these species have been referred to the Pliocene, but the geologists inform us that, at the close of the Pliocene, glacial conditions were already approaching in Great Britain. Migration in higher latitudes must therefore have been somewhat difficult for large, and more so for small, mammals.

Near Grayson (Peters), Nebraska, a half mile or more from Niobrara River and from 50 to 100 feet above it, have been collected many genera and species found in the Aftonian of Iowa. Eighty per cent are extinct. These include *Elephas imperator*, three species of camels, two of horses and a saber-tooth tiger.[4] Since these animals lived, the Niobrara has cut down its channel 50 to 100 feet deeper and moved a mile away.

Afton, Oklahoma, offers us a case in which a first interglacial fauna occurs near the surface of the Equus beds. A spring there, at which mammals for thousands of years quenched their thirst, has never been smothered by a deposit of loess. Besides later fossils, it has furnished five species of horses, two species of camels and *Elephas imperator*. Seventy-three per cent are extinct.[5]

At Frederick, Oklahoma, deep down in an old filled-up river bed on the top of a ridge 100 feet above the surrounding region, the stream now flowing ten miles away, have been collected 25 species of mammals, among them *Elephas imperator?*, *E. haroldcooki*, *Stegomastodon*, *Glyptodon*, five or six species of horses, and at least two kinds of camels. All species are exinct.[6]

[2] O. P. HAY. Carnegie Inst. Washington Pub. **322A**: 286–301.
[3] O. P. HAY. Op. cit. 302.
[4] O. P. HAY. Op. cit. 100, 304.
[5] O. P. HAY. Op. cit. 94, 254.
[6] O. P. HAY and H. J. COOK. Proc. Colorado Mus. Nat. Hist. **9**, No. 2.

At Rock Creek, in Tule Canyon, Briscoe County, Texas, has been collected a large fauna in still other conditions. In late Pliocene or early Pleistocene times, during an uplift, a stream cut a gorge about 100 feet deep into Miocene deposits. Later there was a depression during which were laid down four distinct Pleistocene beds amounting to about 90 feet. Then occurred another change. A quickened stream cut down through all the Pleistocene, through the Miocene and into the Triassic. In the Pleistocene of this canyon have been collected *Glyptodon*, two elephants (one of them *Elephas imperator*), from four to six horses, and four kinds of camels, twenty or more species, all of which are extinct.[7]

Along Brazos River, at Waco, Texas, are three terraces, the highest standing 100 feet above the river. On this terrace have been found remains of *Elephas imperator* and of camels.[8]

At Pittbridge, Brazos County, 13 species of mammals have been collected, including *Chlamytherium*, *Megatherium*, a horse, a camel, three species of mastodons, and *Elephas imperator*. All belong to extinct species.[9]

In Austin County, on Brazos River, 80 miles from the Gulf, near San Felipe, have been collected nine species of extinct mammals, among them *Elephas imperator*, a horse, a camel, two species of mastodons, and a long-horned bison.[10]

Along the shores of Galveston Bay skeletons of elephants are frequently found. One at least of these was *Elephas imperator*.

At Keeran Point, on the Gulf Coast, bones of a large camel have been collected. With these was associated an elephant, possibly *E. imperator*.[11]

A comparison of the lists of fossils cited above as collected in Iowa, Nebraska, Oklahoma and Texas must convince one that all belong to an early stage of the Pleistocene and all to the same stage. Some of the collections cited, and most of those to be cited, contain three groups of species: (*a*) Species which do not occur in more recent deposits; (*b*) Species becoming extinct in later stages; (*c*) Species living into historical times.

[7] O. P. HAY. Carnegie Inst. Washington Pub. 322A: 85, 222, 232, fig. 2.
[8] O. P. HAY. Op. cit. 88, 127, 161, 227, 243.
[9] O. P. HAY. Op. cit. 244, 245.
[10] O. P. HAY. Op. cit. 246.
[11] O. P. HAY. Op. cit. 21, 64, 163, 248.

On map 25 of the author's work, *Publication 322A*, of the Carnegie Institution of Washington, are shown the localities in the middle region of the United States where extinct species of the genus *Bison* have been discovered. In Texas are 16 of these. On map 26 are indicated finds referred to *Bison bison*. Seven in Texas are thus identified, but the writer can not be sure that even one of these is at once *Bison bison* and older than the late Pleistocene. Had this animal lived in Texas with the species shown on map 25, it is hard to explain why no skull or even horn core has been discovered in association with early Pleistocene species. These extinct species were apparently buried when Texas was at a higher elevation and since that time the streams have spent their energy in deepening and widening their valleys. Satisfactorily identified remains of *Bison bison* appear to occur in Texas only on lower river terraces.

I come now to deal with the earliest known Pleistocene mammals of Florida. In this state are some six localities where such remains have been collected. Details regarding these and citations of papers discussing them may be found in the writer's *Publication 322* of the Carnegie Institution of Washington and in Dr. G. G. SIMPSON'S article in the Twentieth Annual Report of the Florida Geological Survey, on pages 231 to 279.

There is general agreement that the collections of the six localities mentioned below are of the same geological age; but there is disagreement as to what that age is.

In "stratum No. 2" (now denominated Melbourne beds) at Vero, St. Lucie County, have been collected 29 species of mammals, of which 21 are extinct, 67 per cent. Among these are 4 species of edentates, 3 species of horses, a capybara, an undetermined camel, and the Florida saber-tooth tiger. Three miles away, in a corresponding formation, was found a jaw of *Elephas imperator*.[12]

From Melbourne, Brevard County, a collection of forty species of mammals has been reported, at least 60 per cent of which are extinct. Among these are *Chlamytherium*, a species of glyptodon, a camel, and *Elephas imperator*.[13]

Seminole Field, Pinellas County, has contributed 46 mammalian species. At least 27 of these are no longer living, 59 per cent. Five

[12] O. P. HAY. Op. cit. 163.
[13] G. G. SIMPSON. Florida Geol. Survey Ann. Rept. **20**: 268.

species of edentates, two horses, three camels, and a saber-tooth are among the number.[14]

Not far from Sarasota, Sarasota County, have been collected 23 species of mammals, of which at least 15 species, 65 per cent, are extinct. Among these are a *Glyptodon*, a camel, a horse, and a saber-tooth tiger.[15]

About seven miles east of Sarasota have been secured 14 species of mammals, 11 of which, 80 per cent, are extinct. These include a camel, *Chlamytherium* and a horse.[16]

Near Arcadia, DeSoto County, along Peace Creek, have been found 12 species of land mammals, of which 11, 91 per cent, are extinct. These include *Glyptodon*, two horses and *Elephas imperator*.[17]

These Melbourne beds and their fossils are now to be compared with those of western Iowa and those found from South Dakota to the Gulf. Certainly the fossils of Florida resemble in a general way those collected in the western region. There are in both states numerous edentates (such as ground sloths, and glyptodons), wolves, bears, great cats, elephants, mastodons, horses, tapirs, peccaries, camels, deer, bisons, gigantic beavers, and gigantic capybaras. Nearly every family of mammals found in Florida occurs also on the Plains. Of 51 genera of Melbourne mammals recorded by Simpson[18] 18 are found also in Texas. Of 70 species of Melbourne mammals 14 are known in Texas; and quite certainly more collecting in the two states will increase the numbers of species possessed in common. Of the genera occurring in the Melbourne beds 23 are recorded from the deposits regarded as Aftonian of the region from western Iowa to the Gulf of Mexico.

The collections made in Florida contain usually more species than those of the western region. This is simply because the Florida fossils were buried in ponds and slowly flowing streams, while those of western Iowa and of the Plains were deposited by swift waters which swept away the bones of the small creatures. At Vero, Florida, occur 29 species, of which seven are small, 24 per cent of the whole. At Melbourne were found 44 species of which four were small, 9 per cent.

At Lecanto 26 species were collected of which eight were small, 30 per cent. At Seminole Field 44 species were secured, 12 of which were small, 27 per cent.

[14] G. G. SIMPSON. Op. cit. 264.
[15] G. G. SIMPSON. Op. cit. 274.
[16] G. G. SIMPSON. Op. cit. 275.
[17] O. P. HAY. Carnegie Inst. Washington Pub. **322**: 381.
[18] G. G. SIMPSON. Florida Geol. Survey Ann. Rept. **20**: 251.

On the other hand, in the Cox pit, near Missouri Valley, Harrison County, Iowa, have been collected 19 species, all of them large.[19] At Peters, Nebraska, have been taken 21 species, only two small, 9 per cent. At Frederick, Oklahoma, have been collected at least 23 species, none small. From Rock Creek, Texas, have been reported 18 species, none small. At Pittbridge, Texas, have been secured 14 species, none small.

If in this region the microfauna were duly represented, the collections would be quite as large in species as those of Florida and probably the number of species common to both regions would be augmented.

It is in order now to determine in what way Florida is related in its Pleistocene mammalian paleontology to that of the Great Plains. In looking over the records it is found that 50 species have been discovered in the collections made in Texas and referred by the writer to the early Pleistocene and that, of these, 16 species are regarded as common to Florida, that is, 32 per cent, and few small species occur. In Nebraska there have been collected apparently 22 species of mammals, very few small forms, and, of these 22, only six are known from Florida, 27 per cent. In Iowa have been secured 25 species of which apparently eight, none small, are known from Florida, 32 per cent.

Now are these differences in the composition of the various collections such as we can or can not expect? Do they indicate different geological stages of existence? Taking into consideration the distance of the Plains from Florida, but more especially the differences in latitude and of faunal zones, what do we find at the present day? So far as I can determine there exist now in Texas 111 species of mammals. Of these 23 live in Florida, 20 per cent. In Nebraska there are approximately 50 existing mammals, of these 11 seem to belong also in Florida, 22 per cent.

It will hardly be questioned that these existing mammals of Florida, Texas, and Nebraska belong to the same geological time; but what reason is there that quite similar differences should not be expected in the case of the animals of an early Pleistocene stage?

The reader who is interested in this discussion is now invited to examine the lists of fossils taken at various European localities from deposits which MAYET and ROMAN call the "Pliocène récent" and the "Pléistocène ancien."[20] This "Recent Pliocene," however, corre-

[19] O. P. HAY. Carnegie Inst. Washington Pub. **322A**: 296.

[20] MAYET and ROMAN. Ann. Univ. Lyon (n.s.) fasc. **42**: 22–68.

sponds to the first and second glacial and first and second interglacial stages of North American geology. Most of the lists cited belong to the first glacial stage, known to us as the Nebraskan, but the deposits lie well outside the glaciated region. The Red Crag, however, is placed by Haug at the top of his period Neogene.[21] The pages of Mayet and Roman's work on which each list begins is here cited.

1. Sables de Chagny (p. 22). The list presents 18 species, of which all are extinct; no small species. Sixteen genera (including subgenera); five of them extinct, 31 per cent.

2. Perrier (p. 29). Thirty-six species, all except one extinct; four or five small. Twenty-seven genera, four extinct, 14 per cent.

3. Du Puy (p. 35). Thirteen species, all extinct; none small. Nine genera, three extinct, 33 per cent.

4. Val d'Arno (p. 50). Thirty-five species, all extinct. Four or five species small. Twenty-five genera, six extinct, 24 per cent.

5. Red Crag (p. 58). Eighteen species of land mammals, all extinct, one small. Sixteen genera, three extinct, 19 per cent.

6. Cromer Forest bed (p. 66). Thirty-eight species, 14 extinct, 37 per cent. Twenty-seven genera, four extinct, 15 per cent. Ten species small.

This locality and its fossils are arranged by the French authors at the top of the Old Pleistocene (Yarmouth). They employ the prevailing nomenclature. It is now believed, however, that most of the species need revision; also many of the genera.

It will be observed that these lists, like those of our country, differ in number of species from place to place and often in the identity of species; but in all of them, for identification of geological position, are a few prominent forms, such as primitive elephants, mastodons, rhinoceroses, *Equus*, etc.; as in America we must rely on *Elephas imperator*, *E. haroldcooki*, *Stegomastodon*, *Equus*, and the Camelidæ. In both these countries these fossils, for the most part, bind the formations to the early Pleistocene; the Cromer fossils attach the Cromer beds apparently to the first or second interglacial stages.

Therefore as regards the Melbourne beds of Florida, the writer is confident that, notwithstanding the prevalent theories of successive Pleistocene submergences and consequent terraces, of dissolution of fossils from these terraces by percolating waters, of terraces formed within 15,000 years; of the notion that Florida was a land where the

[21] HAUG. *Traité de géologie*. 1620.

mammals were protected from glacial storms until rude barbarians came and slew them with their arrows and clubs and stones—notwithstanding these theories, those Melbourne beds belong to the first interglacial stage.

The writer will now consider briefly the Pleistocene paleontology of a portion of the Pacific Coast region. It is necessary to mention only two localities, Fossil Lake, Oregon, and La Brea, near Los Angeles, California.

In deposits of an ancient desiccated lake, now Fossil Lake, have been collected 22 species of mammals and 50 of birds. Of the mammals 12 species, 52 per cent; of the birds 16, 32 per cent, are extinct. Of the mammals three species only are small. Ten of the genera are found in Florida and at least two species. Four species of camels, one horse, and *Elephas imperator* have been collected.[22]

La Brea furnishes a vast number of finely preserved, but disarticulated, skeletons of mammals in deep pits of asphaltum mingled with sand. Forty-four species are recorded, a few not determined specifically. Of these at least 23 are extinct, 57 per cent. Five of the species are known from Florida. Thirty-six genera are present, of which 11 are extinct, in North America at least. Twenty-two of the genera occur also in Florida. About ten species are small. Three species of large edentates, one horse, a bison, five dogs, four large cats (among them a saber-tooth tiger), a camel, and *Elephas imperator* are present. Only five of the species are recorded in Florida.[23]

These localities furnish fossils which indicate first interglacial animals. The essential species are present. In Oregon and California not many are found which are known from the states of the Plains and from Florida; but this is exactly what is to be expected. Let us see how the existing mammals of the Pacific region agree in species with those of the eastern third of the United States.

From Mr. G. S. MILLER'S *Mammals of North America*, 1924, I make out that in the states east of Mississippi River there are close to 116 species of mammals. In the 11 States, New Mexico, Colorado, Wyoming, Montana, and those between these and the Pacific Ocean, there are approximately 356 species. Of these there appear to be about 27 species common to the two regions, about 7 per cent of those of the western region, and about 23 per cent of those of the eastern.

[22] O. P. HAY. Carnegie Inst. Washington Pub. **322B**: 243.
[23] O. P. HAY. Idem. 183.

In Florida there exist about 40 species of mammals; in California approximately 190. I find only eight species common to the two states.

If the fossils of Fossil Lake and of La Brea are not regarded as contemporaneous with those of the Plains and of Florida, geologists of some æons hence who may have in hand fossils of the present day mammals of the eastern third of our country and of the western third would, on the same grounds, be justified in referring them to quite different geological stages or epochs.

ETHNOLOGY.—*The music of the American Indians at public gatherings* (Abstract).[1] FRANCES DENSMORE, Bureau of American Ethnology.

Music was an important factor in public gatherings of the Indians and they derived much pleasure from it, yet there were no concerts and the European custom of ballad singing was unknown. The American Indian never sang for the approval of others, neither did he sing in order to be paid for his performance. His pleasure in music was not connected with technic but with the melodies, their words, and certain associations of the songs. In the old days every Indian song was an inspiration, not a creation of man according to rule and precept.[2]

After describing the Indian custom of "receiving songs in dreams" the writer considered her subject under four divisions: poetry, drama, dancing and games. The accompanying instruments were various forms of drums and rattles producing rhythm but not melody.

The poetry of the Indians is contained in the words of songs and rituals. There is no attempt to interpret these words by the manner of rendering the songs. Many song-cycles of southwestern tribes relate the journeys of mythical personages, and the people dance during a portion of these songs. The beauties of nature form the subject of many songs, the words being few but highly poetic.

Primitive drama is closely associated with music. There is rich

[1] Received Oct. 9, 1930. The paper of which this is an abstract was read by Miss Elizabeth Burchenal, September 1, 1930, at the International Congress of Popular Arts, held at Antwerp. It was the only paper from the United States on the program. The other papers were from England, Spain, Holland, Belgium, Germany, France, and Italy.

[2] With reference to my paper on the music of the American Indian (this JOURNAL 18: 395–408, 1928), Prof. CONSTANS MALTEZOS, a member of the Academy of Athens and a student of ancient oriental and Peruvian music, who had thought that there might be an intelligent system underlying the music of the American Indians, writes me as follows: "Je trouve que vous avez raison: vos Indiens ne pouvent avoir eu une idée de intervalle du ton. Cette musique n'a pas passé par le mains de théoreticiens."

pageantry, as well as music, in the ceremonies to bring rain. The Sun Dance of the Plains tribes had its ceremonial songs, and the warrior dramatized his victory over the enemy. Among the Sioux, the man who had received a vision acted it out, that all might know he had the elk or the bear as his spiritual helper, and he sang the song given in his vision. The history of Indian tribes is replete with drama in ritual and ceremony.

Dancing differs in style among the various tribes, some maintaining a dignified manner while others have contests in acrobatic dancing with many contortions. There are dances of individual expression, dances imitating birds and animals, and dances in which the people stand still, flexing the knees, but in a majority of Indian dances the people move in a circle around a large drum.

Games of pure skill and calculation, like chess, are unknown among the American Indians, their games being contests of dexterity or games of chance. Success in games was formerly attributed to supernatural aid, and songs were sung to ensure that aid.

In closing, the writer described various customs connected with Indian music and noted the absence of self-aggrandisment on the part of Indian musicians. It was the old belief that songs were given by friendly spirits, and their use was chiefly associated with securing help and benefit to human beings.

PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

ENTOMOLOGICAL SOCIETY

421ST MEETING

The 421st regular meeting of the Entomological Society of Washington was held at 8 p.m., Thursday, June 5, 1930, by special invitation at the University of Maryland, beginning with an informal picnic and basket dinner from 6 to 8 p.m. on the campus and continuing with the formal session at 8 p.m. in the University Auditorium at College Park, Maryland. J. E. GRAF, president, presided. H. L. PARKER, European Parasite Laboratory, Hyères, Var, France; NEWELL E. GOOD, Bureau of Entomology, Washington, D. C.; and JAMES ZETEK, Barro Colorado Island Biological Laboratory, Canal Zone, were elected to membership in the society.

A brief informal address was given by H. J. PATTERSON, Director of Maryland Agricultural Experiment Station, in which he greeted the society and extended welcome for all to the University. He then read a note from R. A. PEARSON, the President of the University, expressing regret at inability to be present and writing in highly appreciative terms of Doctor Howard and their personal associations. Doctor Patterson expressed hope that all the scientific

organizations of Washington would continue more and more to make regular use of the facilities of the University for various gatherings and assured a hearty welcome to all. He also referred to the practical value of entomological work and the annual savings effected through such research, and made very brief mention of the work of some of the early entomologists connected with the Maryland Station or the University, and the publications issued therefrom dealing with entomological topics. He stated that all were honored by the presence at the meeting of Doctor Howard, and an especial welcome was extended to him

E. N. CORY also made a very brief address of welcome to the society and referred appreciatively to the work of the various entomologists connected with the Maryland institution, many of whom were later with the Federal Bureau.

Program: L. O. HOWARD, of the U. S. Bureau of Entomology, *Some early entomologists.* Apropos of the letter from Doctor Pearson just read, Doctor Howard spoke appreciatively of the association reaching back for thirty years or more with Doctor Pearson, and of the latter's ability to "pull ideas down from the sky." It was due to one of these ideas that Doctor Howard first was made one of the trustees of Cornell University. In discussion of his subject, Doctor Howard placed especial emphasis on reminiscences of the careers of certain of the early entomologists who had been connected in one way or another at various periods of their lives with the work of the Maryland Station. The first of these to whom consideration was given was Townend Glover, who later was the first entomologist of the U. S. Department of Agriculture, and a brief résumé of his biography was given with special emphasis on his very strongly marked individuality and his personal eccentricities. All interested were advised to read the vivid and colorful biography of Glover by Charles Richard Dodge, published in 1888 as U. S. Division of Entomology Bulletin, old series, No. 18. Several extracts were read by the speaker from various papers not yet published dealing with sundry phases of Glover's career. There was also considerable discussion by the speaker of other entomologists connected at one time or another with the Maryland Station, including C. V. Riley, R. S. Lull, W. G. Johnson, E. D. Sanderson, and others. Slides bearing portraits of these and a number of their contemporaries in entomological work were shown and various phases of the career of each individual were given brief consideration.

W. D. PIERCE discussed some entomological experiences in the Philippines, under the title *The sugar-cane insect problem in Negros*; an abstract of this will be published later in the Proceedings of the Entomological Society of Washington. Doctor Pierce's remarks were discussed by GRAF, GAHAN, BISHOPP, and HOWARD.

A. B. GAHAN reported the recent rearing by MCCREARY, of the University of Maryland, of *Dicymolomia julianalis* Walker, a small moth which he found to be feeding on the eggs of the common bagworm of evergreens (*Thyridopteryx ephemeraeformis* Haw.). Mr. Gahan first observed this insect in a similar relation to the bagworms some fifteen years ago in the same locality, while connected with the University of Maryland. So far as he knew, no other like observation had been made by any other person since that time. The normal habit of the moth is said to be to infest the heads of the common cattail or Typha.

Professor CORY reported the recent finding of Argentine ant (*Iridomyrmex humilis* Mayr) in a greenhouse in Baltimore, Maryland. This is a new dis-

tribution record and is the northernmost point of the known spread of this pest.

AUSTIN H. CLARK, *Notes on some local butterflies.* This has been published in the Proceedings of the Entomological Society of Washington, **32**: 80–82, 1930.

On motion of F. C. Bishopp, a vote of thanks was extended by the society to the authorities of the University of Maryland and to Professor Cory and his associates for the generous hospitality and for the splendid welcome given our society at the 421st meeting.

J. S. WADE, *Recording Secretary.*

Obituary

OLIVER PERRY HAY, a member of the Academy and of the Biological and Geological societies, died November 2, aged 84. He was born at Saluda, Jefferson County, Indiana, May 22, 1846, and studied at Eureka College, Yale University, University of Indiana, and the University of Chicago. After teaching several years at Eureka College and at Butler College, he became, in 1895, an associate curator in the Field Museum. He was engaged in research work at the National Museum from 1897 until 1900, when he was appointed assistant and later associate curator in the department of vertebrate paleontology of the American Museum of Natural History. In 1907 he returned to Washington. He was a collaborator of the Carnegie Institution of Washington from 1902 to 1906; research associate, 1912 to 1916; and associate from 1917 until his retirement in 1926.

He was the author of many papers on vertebrate paleontology. His longer works include a *Bibliography and catalogue of the fossil Vertebrata of North America* (1902), *The fossil turtles of North America* (1908), *The Pleistocene age [of Indiana] and its Vertebrata* (1912), *The Pleistocene mammals of Iowa* (1914), and three volumes on *The Pleistocene of North America and its vertebrated animals* (1923, 1924, 1927). Dr. HAY was a frequent contributor to this JOURNAL. His last contribution, which appears in this number, was handed to the editor only a few days before his death.

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